



From a photograph made for POPULAR RADIO

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## The Motion Picture Speaks

*How the long-cherished dream of inventors to make the "motion picture speak" has at last been solved by the radio experts, who are causing sound successively into electric current, light waves, picture and back again into sound.*

LEE DE FOREST, Ph. D., D. Sc.

TALKING movies are an accomplished fact. Perfect synchronism of speech and action has been attained, and this success is another triumph for that wonder worker of radio, the audion amplifier. The talking movie depends upon the use of the tubes to amplify the minute electric currents with which it is necessary to work and it is no exaggeration to say that the vocalization of the motion picture would never have been accomplished at all were it not for the fact that the motion picture technicians had available to them the perfected inventions of the radio engineer.

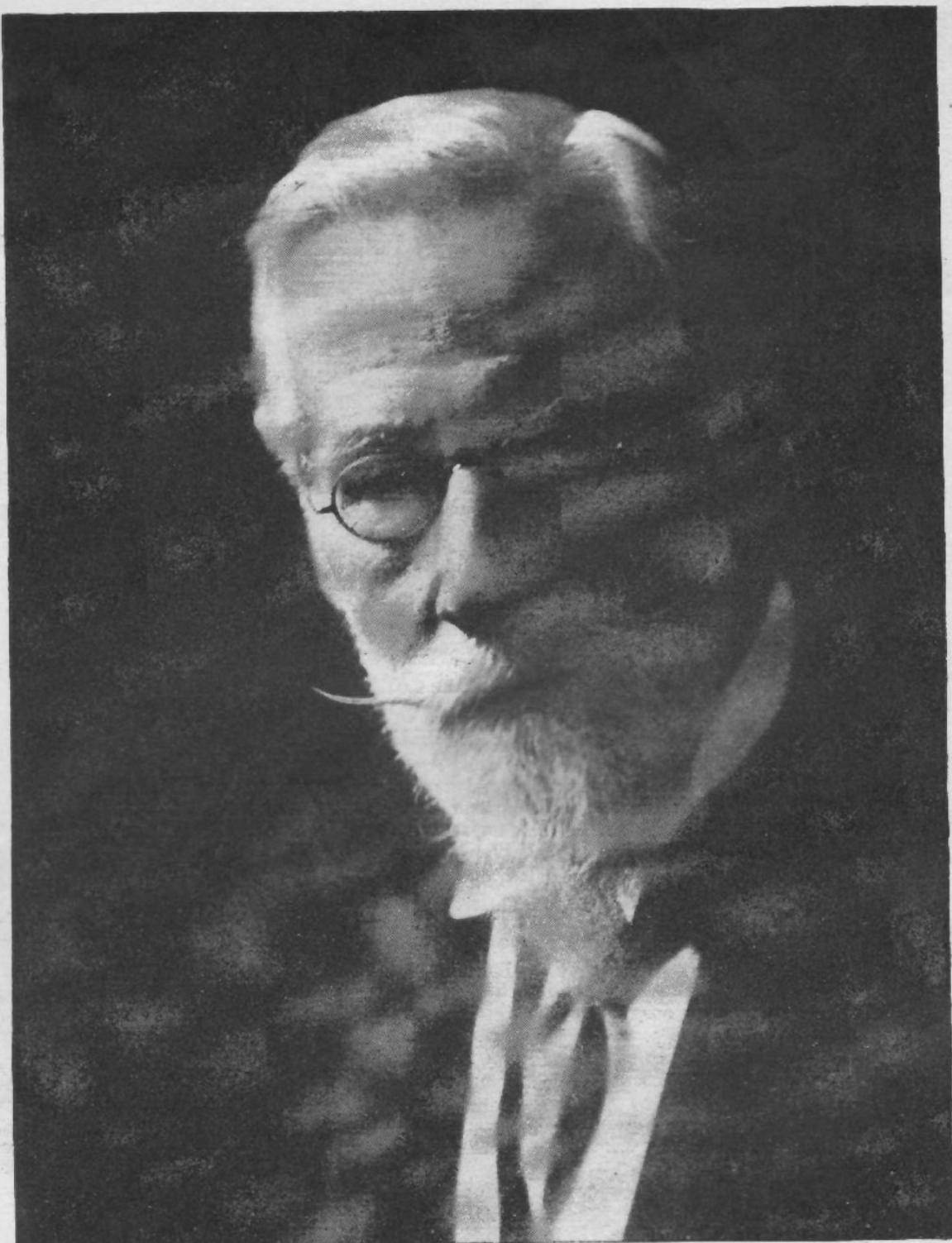
The earlier attempts at talking movies, fiascos which we all remember so well, depended upon schemes for connecting together an ordinary phonograph and an ordinary motion picture machine. The phonograph was supposed to repeat a certain sound at the exact instant that the appropriate action took place on the screen. To make the two machines run precisely at the same rate there were complicated arrangements of governors

and regulators. In one of the pictures, for instance, small holes were at intervals in the film. Compressed air escaped through these holes and drove a piano player and this escape was supposed to regulate the speed of the phonograph so that it would record at a rate exactly equal to the progress of the film.

None of these devices worked well. Not only were there delicate mechanical or electrical adjustments which frequently got out of order, but there was another difficulty, one which was entirely unforeseen, probably, but not actually experienced in the picture business. This was the breaking of the record caused by the breakage of the film.

Once in a while when you are projecting the pictures in a motion picture you will see the picture disappear, leaving a blank white space. This means that the film has torn. The young man in the projecti-

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From a Photograph by Hoppé, London

### The First Man to Create a Stream of Electrons in a Vacuum Tube

While SIR WILLIAM CROOKES was experimenting with his own invention, the Crookes tube, in 1876 he noticed for the first time a glow discharge that "flew away from the cathode in radial lines." His investigations of this phenomenon led to the discovery of the X-ray by Roëntgen in 1895 and ultimately to the acceptance of the electron theory by scientists throughout the world.

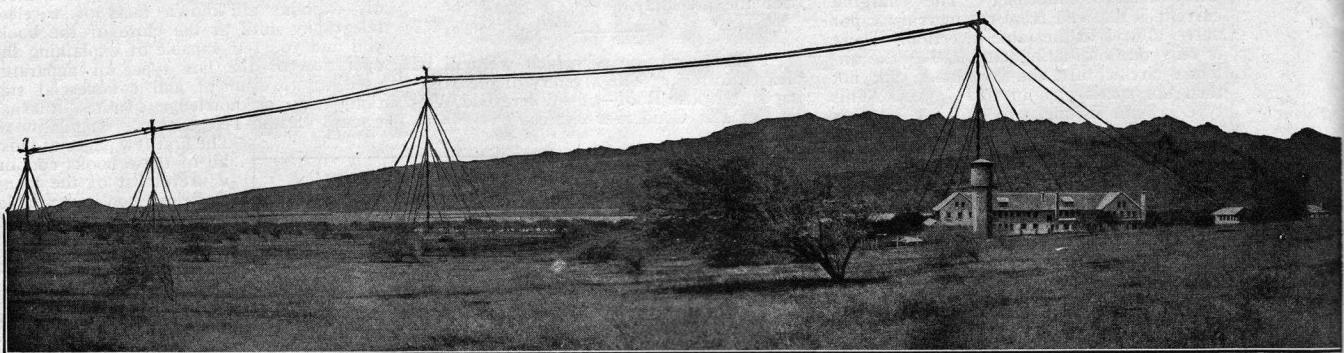


Courtesy of J. E. Williamson

#### THE FIRST MAN TO TRANSMIT SOUND ON BEAMS OF LIGHT

Back in 1880 Dr. Alexander Graham Bell invented the "photophone," by means of which speech was transmitted 200 yards on a ray of sunlight reflected from a curved mirror. In the picture above the good doctor is revealed as a diving Bell; it was snapped while he was emerging from the Williamson submarine tube in the West Indies, shortly before his death.

## United States and Japan Linked by Radio



From the Operating House as a Center, the San Francisco Aerial (at Left) at Koko Head is Carried on Five 330-Foot Masts to an Anchorage. The Japan Aerial (at Right) Extends From the Operating House Almost Due East. The First Two masts are of the Standard Sectional Type, 430 Feet in Height. The Aerial Makes a Span of More Than 2,000 Feet to the Top Edge of Koko Head, an Extinct Volcano, at an Elevation of 1,194 Feet Above the Sea Level; Here There was Not Room Enough to Erect a Sectional Mast, Only About Forty Square Feet Being Available for a Self-Supporting Structural Tower 150 Feet in Height. The Tail End Anchorage is Far Down on the Inside of the Crater. The Balancing Aerial, Which is Employed in Both Sets of Antennae, is on Self-Supporting Towers, Each of Which is 100 Feet in Height.

**T**HE epoch-marking event of radio-communication between San Francisco, U.S.A., and Funibashi, Japan, was recorded in these columns in the January issue. We present herewith an interesting view of the monster trans-Pacific station of the Marconi world-girdling chain of such stations as erected at Koko Head, Hawaii.

The American Marconi Company engineered the following units in the world chain: Trans-Atlantic stations at New Brunswick and Belmar on the New Jersey coast to send and receive messages to and from corresponding stations in Wales; sending and receiving stations respectively at Bolinas and Marshall, Cal., linking the Pacific coast with the Hawaiian stations, Kahuku and Koko Head (shown here), two similar stations in Manila, the Philippine Islands, and receiving and transmitting stations at Marion and Chatham, Mass., to connect in Norway with Stavanger and Naerbo.

From the operating house as a center, the San Francisco aerial (at left) at Koko Head is carried on five 330-foot masts to an anchorage. The Japan aerial (at right) extends from the operating house almost due east. The first two masts are of the standard sectional type, 430 feet in height. The aerial makes a span of more than 2,000 feet to the top edge of Koko Head, an extinct volcano, at an elevation of 1,194 feet above the sea level; here there was not room enough to erect a sectional mast, only about forty square feet being available for a self-supporting structural tower, 150 feet in height. The tail end anchorage is far down on the inside of the crater. The balancing aerial, which is employed in both sets of antennae, is on self-supporting towers, each of which is 100 feet in height.

The problems of construction at Kahuku which is now being employed both as a sending and receiving station, were not as great as those at Koko Head, altho the former is the largest wireless station in the world. From the power house the San Francisco transmitting aerial is supported by twelve masts, each of which is 325 feet in height; the Japanese aerial is supported by twelve masts, each being 475 feet in height.

The mast is made up of steel cylinders, constructed in quarter sections flanged vertically and horizontally and secured together by bolts. Stayed with steel cables, these stand in a concrete foundation. Surmounting the main steel column was a wooden

topmast, the lower part of which is squared and set in square openings in the plates between the steel cylinders. The hoisting arms attached to the upper end were fitted with blocks and hoisting cables. Attached to these arms were chain hoists which supported a square wooden cage for the workmen, which was lowered or raised as the demands of the work required while the sections were being bolted together.

The stays, by means of which each mast is supported, are made of heavy plough steel cable, possessing great tensile strength. For each mast thousands of feet of this cable were used, great care being taken to see that the elastic extension of these stays was not so great as to result in the vibration of the mast during heavy winds.

Great quantities of wire were placed in the ground about the stations in order to provide an efficient earthing system or ground connection. In brief, a circle of zinc plates is buried in a trench, bolted together and joined to the wireless circuits of the power house by copper wire. Wires radiate from the zinc plates in the ground to a set of outer plates, from which extend another set of earth wires placed in trenches running the full length of the aerial.

The capacity of each of the generators employed in the stations of the United States-Japan circuit, with the exception of that at Funabashi, is 300 kilowatts. These generators are driven by 500 horsepower motors, except at Kahuku, where 500 horsepower turbines are used.

The distinctive feature of the aerials at the Marconi trans-Pacific stations is that they are directional, that is, the radiation of wireless signals in the desired direction is very much stronger than in any other. This control of the signals is a long step ahead in wireless communication. All of the stations are of the duplex type and can receive and transmit signals at the same time.

The automatic sending and receiving apparatus plays an important part in wireless communication between the Occident and the Orient. The sending machine somewhat resembles a typewriter and will make possible the transmission of more than 100 words a minute. Under the automatic system, ten or 100 messages can be filed at the same time at the office of the Marconi Company in Honolulu. They are distributed among the necessary number of operators and the dots and dashes punched in a paper tape by a machine. This tape is fed into an automatic sender and the sig-

nals conveyed by land line to Kahuku, where the dots and dashes actuate a high-power sending key, automatically energizing the aerial instantaneously with the feeding of the tape in the station, thirty miles or more away. At the transmitting station the dots and dashes operate magnets of the high-power sending key in the main energy circuits and the signals are flashed to the points which the destination of the message calls for—either Marshall or Funabashi. If the message is destined for Marshall it will be received on a specially constructed dictaphone machine, each cylinder, as soon as it is filled with dots and dashes, being handed to an operator who will transcribe it into a typewritten message by means of a dictaphone machine running at normal speed.

For the present the Marconi United States-Japanese service will be confined to San Francisco, Hawaii and Japan. There will be two classes of service between San Francisco and Japan, a full rate or expedited service at eighty cents per word, a reduction of forty-one cents per word from the existing cable rates, and a deferred half rate service at forty cents per word, the lowest cable rate at present being \$1.21 per word.

### RADIO PROVES HOW "NEWS" IS DELETED.

Two striking examples of British deletion and suppression of news transmitted to the United States have come to light by comparison of identical war office reports filed simultaneously at Berlin for transmission to New York, the one by cable, via London and the other by wireless, via Sayville.

The first is a Bulgarian war office statement. The wireless and cable reports were alike except that from the latter, which past thru the British censorship, was omitted a paragraph announcing the destruction by a mine in the Black Sea of the Russian dreadnaught, *Imperatritsa Naria*.

The second is a German war office statement. As transmitted by wireless, unedited by the British censor, it read:

"In a house-to-house engagement near the Sainly-Saillisel Church the French gained no advantage. Attacks launched there on a large front also failed."

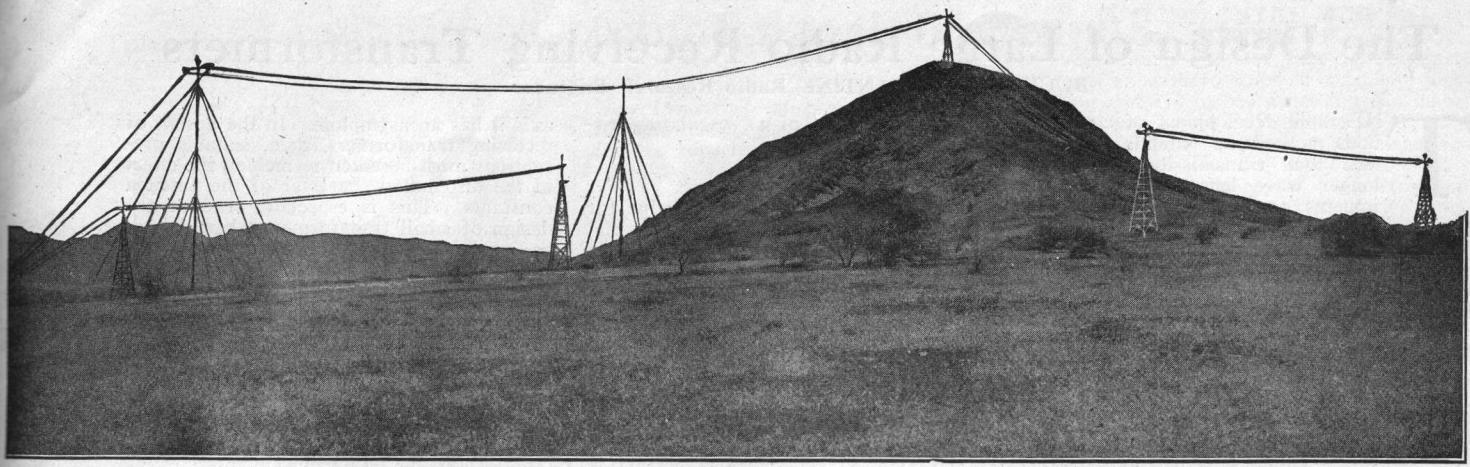
The same statement received by cable after censoring read:

"House-to-house fighting near the Sainly-Saillisel Church brought the French small advantages. Otherwise attacks there on a wide front failed."

February, 1917

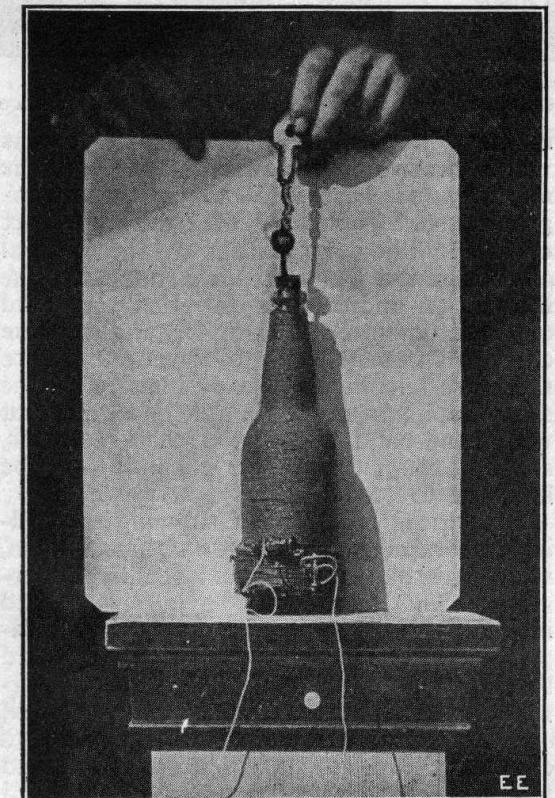
THE ELECTRICAL EXPERIMENTER

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## A "BOTTLE" HIGH FREQUENCY TESLA COIL.

The high frequency coil shown in the photograph was made by winding an old



Tesla Coil Made from Bottle and Capable of Giving a 3-inch Spark.

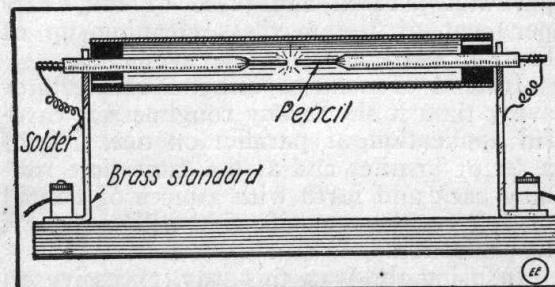
bottle, near the bottom, with a primary of six layers of No. 12 rubber covered wire. The secondary winding consists of a layer of No. 20 D.C.C. wire carried to the top. The knob on top is made from an old bell tapper inserted in the cork. The coil shown is capable of delivering a three inch spark when properly connected.

Contributed by A. E. GLAZIER.

## SIMPLE EXPERIMENTAL ARC.

This quickly made arc consists of a glass tube, fitted at both ends with cork plugs, or stoppers, thru which pass two ordinary writing pencils cut so as to have their graphite rods protruding at both extremities. The battery wires are connected as shown in Fig. 1.

Such an arc answers very well for experimental purposes and gives excellent



Experimental Arc Formed of Two Lead Pencils in Glass Tube.

results when connected to about 18 volts.  
Contributed by JOHN T. DWYER.